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Maximizing potential impact of experimental research into cognitive processes in health psychology: a systematic approach to material development

Alicia M. Hughes¹, Rola Gordon¹, Trudie Chalder¹, Colette R. Hirsch^{1*} and Rona Moss-Morris^{1*}

¹ King's College London, Institute of Psychiatry, Psychology and Neuroscience, London, United Kingdom

* Joint last author

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Requests for reprints should be addressed to Rona Moss-Morris, Health Psychology Section, Psychology Dept., Institute of Psychiatry Psychology and Neuroscience, KCL, 5th floor Bermondsey Wing, Guy's Hospital Campus, London Bridge, London SE1 9RT (e-mail: Rona.moss-morris@kcl.ac.uk).

Abstract

Background: There is an abundance of research into cognitive processing biases in clinical psychology including the potential for applying cognitive bias modification techniques to assess the causal role of biases in maintaining anxiety and depression. Within the health psychology field there is burgeoning interest in applying these experimental methods to assess potential cognitive biases in relation to physical health conditions and health-related behaviours. Experimental research in these areas could inform theoretical development by enabling measurement of implicit cognitive processes that may underlie unhelpful illness beliefs and help drive health-related behaviours. However, to date, there has been no systematic approach to adapting existing experimental paradigms for use within physical health research. Many studies fail to report how materials were developed for the population of interest or have used untested materials developed ad-hoc. The lack of protocol for developing stimuli specificity has contributed to large heterogeneity in methodologies and findings. **Purpose:** In this article we emphasize the need for standardised methods for stimuli development and replication in experimental work, particularly as it extends beyond its original anxiety and depression scope to other physical conditions. **Method:** We briefly describe the paradigms commonly used to assess cognitive biases in attention and interpretation, then describe the steps involved in comprehensive/robust stimuli development for attention and interpretation paradigms using illustrative examples from two conditions; chronic fatigue syndrome and breast cancer. **Conclusions:** This article highlights the value of performing rigorous stimuli development and provides tools to aid researchers engage in this process. We believe this work is worthwhile in order to establish a body of high quality and replicable experimental research within the health psychology literature.

Introduction

Several decades of research in clinical psychology have identified that how people process incoming information, specifically having an attentional bias to threatening information (attentional bias) and a bias to interpret ambiguous information in a negative way (interpretation bias), plays a central role in the onset and maintenance of anxiety and depression (Beck, 2002; Beck & Clark, 1997; MacLeod, Mathews, & Tata, 1986; Mathews & MacLeod, 2005; Mogg, Mathews, & Eysenck, 1992; Wilson, MacLeod, Mathews, & Rutherford, 2006). Within health psychology, there is burgeoning interest in applying these experimental methods to assess potential cognitive processing biases in physical health conditions, such as chronic pain (Pincus & Morley, 2001; Schoth, Nunes, & Liossi, 2012), chronic fatigue syndrome (Hughes, Hirsch, Chalder, & Moss-Morris, 2016), irritable bowel syndrome and cancer (Chan, Ho, Tedeschi, & Leung, 2011) as well as health behaviours such as eating, (Beard, Sawyer, & Hofmann, 2012; Dobson & Dozois, 2004, van Beurden, Greaves, Smith, & Abraham, 2016), smoking (Bradley, Mogg, Wright, & Field, 2003) and alcohol use (Field, Mogg, & Bradley, 2005; Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011). Experimental research in these areas could inform theoretical development by enabling access to levels and types of information processing that may underpin unhelpful illness representations and influence health behaviours (Sheeran et al., 2016).

To date, health psychology theories have often neglected the role of these less conscious processes in behaviour and coping (Sheeran, Gollwitzer, & Bargh, 2013); assuming behaviour is predominantly driven by conscious processing, for example the theory of planned behaviour (Ajzen, 2011). However, some prominent health psychology models acknowledge a role for more implicit processes. Leventhal's self-regulatory model (Leventhal, 1980, 1984; Leventhal et al., 1997) proposes that illness representations are crucial to understanding human adaptation and response to illness and that, importantly, these

illness representations can be activated by stimuli at any level. The role of explicit illness representation in adjustment to illness, adherence to treatment, and psychological and clinical outcomes has received vast empirical support across a range of conditions (Hagger & Orbell, 2003; Petrie & Weinman, 2006). However, the role of ‘nonconscious’ or implicit processes that may be activating these illness representations has been lesser explored, particularly in physical health and chronic illness.

These more implicit levels of processing require alternative methods of assessment than self-report questionnaires. Clinical psychologists have led research in this field, developing computerized experimental methods to tap into how people implicitly process salient, emotive and threatening information. The rationale was that salient information to the individual would be preferentially processed above that of neutral information (Riemann & McNally, 1995; Tamir & Robinson, 2007; Yiend, 2010).

These methods have been employed in research into health behaviours and to a lesser degree physical health conditions. The chronic pain literature in particular, has employed these experimental methods to test the role of hypervigilance to pain (Crombez, Van Ryckeghem, Eccleston, & Van Damme, 2013) as well as pain related interpretations of ambiguous information (Schoth & Lioffi, 2016). Experimental research has begun to be carried out in other long term conditions such as Chronic Fatigue Syndrome (Hughes et al., 2016), Irritable Bowel Syndrome (Afzal, Potokar, Probert, & Munafò, 2006; Chapman & Martin, 2011; Tkalcic, Domijan, Pletikosic, Setic, & Hauser, 2014) and fear of cancer recurrence (Butow et al., 2015; Custers et al., 2015; DiBonaventura, Erblich, Sloan, & Bovbjerg, 2010; Miles, Voorwinden, Mathews, Hoppitt, & Wardle, 2009). However, to date, evidence for cognitive biases in these areas has been mixed. One reason for the heterogeneous findings may be the suboptimal selection of stimuli materials to tap into salient concepts of the target population (Hendrikse et al., 2015; Hughes et al., 2016). Some

studies have used materials developed for other populations, for example studies of attentional biases in CFS (Hou, Moss-Morris, Bradley, Peveler, & Mogg, 2008; Hou et al., 2014) have used materials developed for the general population to tap into health threats (Lees, Mogg, & Bradley, 2005), which may not be integral to the specific concerns of the population. More specific and distinct types of stimuli are needed in order to help refine our models and allow for stimuli specific predictions. Whilst some material development and validation work has been carried out in some studies (Andersson & Haldrup, 2003; Crombez, Hermans, & Adriaensen, 2000; Keogh, Ellery, Hunt, & Hannent, 2001; Moss-Morris & Petrie, 2003) many fail to thoroughly address this issue, selecting materials from previous literature without validation (Dehghani, Sharpe, & Nicholas, 2003), gaining ratings of stimuli from unrelated populations (Martin & Alexeeva, 2010; Tkalcic et al., 2014), or failing to report how materials were selected or categorized (Asmundson, Carleton, & Ekong, 2005; Roelofs, Peters, Fassaert, & Vlaeyen, 2005).

Given that patterns of processing biases are most pronounced for stimuli specifically related to the principle domain of concern that characterizes that particular disorder (Gotlib, Krasnoperova, Yue, & Joormann, 2004), it is essential that preliminary work is conducted to identify clinically relevant stimuli, salient to the particular clinical group and integral to the concepts in which they intend to tap into. We argue that a systematic approach to stimuli development across the experimental literature would enhance the content validity of the stimulus materials and enable further specificity in the conclusions drawn for experimental research in different populations.

In this paper we briefly describe the paradigms commonly used to assess cognitive biases, and then propose a series of steps for developing condition specific salient stimuli for attention and interpretation paradigms; providing tools to assist this process and illustrative examples from two conditions, CFS and breast cancer. These cases have been chosen as two

distinct populations in which some experimental research has been conducted but produced inconsistent results. CFS is a condition of severe, debilitating and enduring fatigue (Fukuda et al., 1994). Breast cancer is a specific life threatening event that can have an emotional impact of an individuals' life for years to come (Ganz et al., 2002). Cognitive processes may play a role in how people with both these conditions cope with on-going symptoms and specific health threats.

Examples of methods of assessing cognitive processing biases

Attentional bias (AB)

Three paradigms are commonly used to assess AB, the modified emotional Stroop task (Williams, Mathews, & MacLeod, 1996); the visual probe task (MacLeod et al., 1986) and the exogenous cueing task (Posner, 1980; Posner, Walker, Friedrich, & Rafal, 1984). These tasks use reaction time to neutral versus emotive stimuli to determine an AB score. Emotive stimuli are either words or images relating to the concept of interest and salient to the participant group. For example, previous studies in chronic pain have used words such as 'aching' and images of people in pain. These salient, emotive or 'threatening' stimuli are paired with control stimuli which are usually neutral and/or positive. Quicker reaction time to threatening stimuli compared to control stimuli is thought to indicate an attentional bias for such information.

Interpretative bias (IB)

There are a variety of IB paradigms in use (for review see, Hirsch, Meeten, Krahe, & Reeder, 2016). All require the participant to resolve some form of ambiguous information by inferring an interpretation. A commonly used IB task is ambiguous scenarios task (Mathews & Mackintosh, 2000), whereby participants are presented with real world scenarios, each starting with a title and ending ambiguously. After reading a selection of scenarios they are presented with a 'recognition test', where they rate four sentences (one positive interpretation,

one negative interpretation and a positive and negative foil) to the degree to which they are similar or dissimilar in meaning to the original text. The rationale is that high similarity ratings of the recognition sentence relating to a negative interpretation of the text, is indicative of a more negative interpretation of the ambiguous information. The foil sentences are included to rule out the possibility of participants endorsing any material of a certain valence (positive or negative) without truly interpreting the text.

In this paper we will describe steps involved in developing ambiguous and appropriate IB materials which can be used for any IB task, with specific examples of material development for the ambiguous situations task. IB materials need to be devised to allow for both positive and negative inferences to be generated. In order to assess interpretations that maintain a given problem, IB materials should focus on the type of ambiguity people face in everyday life at times when the central component of interest is operating (Hirsch et al., 2016). All recognition statements should be realistic but distinctly positive or negative. The interpretation items should be equally credible resolutions to the ambiguous scenario. The foil items should be related to the original text but have an obvious factual inaccuracy. Examples of IB items such as those used in the ambiguous scenarios task are presented in Appendix C.

Selecting appropriate materials to tap into central ambiguous concepts for a given physical health problem (hypothesis development & refinement)

Before embarking upon the development of appropriate materials for experiments, researchers need to identify the salient concept(s) they wish to tap into, based on a sound theoretical rationale. For example, the fear avoidance model of chronic pain (Vlaeyen & Linton, 2000) proposes that fearful patients become increasingly vigilant to signals of bodily threat, which in turn leads to avoidance behaviour and increased disability. As such experimental research in chronic pain based on this theory have used materials which tap

into bodily threat, e.g. words and images relating to the sensory (e.g. throbbing, sharp) and affective (e.g. agonizing, punishing) experience of pain (Crombez, Van Ryckeghem, Eccleston, & Van Damme, 2013; Roelofs, Peters, Fassaert, & Vlaeyen, 2005). However, other applications of experimental research in areas of health and physical illness have often poorly defined theoretical concepts and have tended to tap into broadly defined concepts, such as general health anxieties (Hou, Moss-Morris, Bradley, Peveler, & Mogg, 2008) or social threat (Chapman & Martin, 2011). These broader concepts are informative for exploring psychopathology but do not draw or build upon an illness specific theory driven approach. Experimental studies should be guided by a sound rationale as to when, how and why cognitive biases may play a role in the specific group of interest. This theory driven approach should guide researchers to identify concepts of experimental interest.

Stimuli development and testing

The next step is to develop and pilot relevant materials. Materials need to map directly onto the key concepts pertinent to a given bias that may be central to the clinical problem. Given this may vary between people the materials need to span the main, common themes or aspects of the problem. Here we propose a systematic and robust approach to stimuli development and testing, with associated tools to aid researchers with this process (Figures 1 and 2) and provide illustrative examples of stimuli development for two populations;

Illustrative example 1 – CFS: In order to assess whether people with CFS have an AB for CFS-related stimuli and/or an illness related IB, appropriate materials that capture key aspects of CFS were developed. This research builds upon cognitive behavioural models of CFS which propose that physiological factors interact with cognitive and behavioural responses to illness to perpetuate symptoms and disability (Chalder, Butler, & Wessely, 1996; Knoop, Prins, Moss-Morris, & Bleijenberg, 2010; Vercoulen et al., 1998). Selective

attention towards health threatening information and a tendency to interpret ambiguous information in a health threatening way, may also contribute to this vicious circle.

Illustrative example 2 – Breast Cancer: In order to determine whether disease-free breast cancer survivors attend to and interpret cancer and symptom related information following treatment, cancer related materials were developed that mapped onto key concerns of this population. The rationale was that a selective processing of threatening cancer information and interpretation of potentially cancer related information in a negative way may have triggered or reinforced distress.

Step 1: Pooling materials

As with any research, we begin with ‘what is known’ on the subject. Have any experimental studies been conducted in this area before? If so, what materials did they use? How were these materials selected? Are there any experimental studies in areas with some overlap with the area of interest? What explicit measures are used to assess the type of concepts of interest? In order to aid this process we propose that researchers make materials easily available, to aid information sharing and replication, as well as being transparent about the conceptual model which led to the operationalisation of these stimuli.

Example 1. Attention: As a starting point to developing AB materials to tap into CFS related concerns, we pooled materials from previous experimental studies in CFS (Hou et al., 2008; 2014; Moss-Morris & Petrie, 2003) as well as chronic pain (Schoth et al., 2012) and general health anxiety (Lees, Mogg, & Bradley, 2005; Owens, Asmundson, Hadjistavropoulos, & Owens, 2004). *Interpretation:* In order to identify salient topics which may elicit an interpretation bias in CFS, we drew from the Cognitive Behavioural Responses Questionnaire (Cella, White, Sharpe, & Chalder, 2013; Skerrett & Moss-Morris, 2006) and Illness Perceptions Questionnaire (Moss-Morris et al., 2002; Weinman, Petrie, Moss-Morris, & Horne, 1996).

Example 2. Attention: Initial AB material was pooled from cognitive biases studies in cancer populations (Butow et al., 2015; Custers et al., 2015; Glinder, Beckjord, Kaiser, & Compas, 2007) as well as healthy populations with anxiety about cancer (DiBonaventura, Erblich, Sloan, & Bovbjerg, 2010). *Interpretation:* For the development of ambiguous situations for the IB task, initial topic areas were generated from searching cancer survivorship literature (Costanzo et al., 2007; Fenlon et al., 2015; Miles, Voorwinden, Mathews, Hoppitt, & Wardle, 2009).

Step 2: Focus groups & interviews

The pooling process results in an accumulation of potentially useful but non-specific materials. The next stage is to use qualitative methods to identify salient illness specific concerns and extract vocabulary or images directly generated by the patient or target group.

Example 1. One to one interviews with CFS participants explored the experience of CFS using open questions and prompted interviewees to recall real-life examples that captured these experiences. A workshop with six clinically trained psychologists and cognitive behaviour therapists who specialize in the treatment of CFS, discussed the ways in which their patients typically described their experience of CFS and recurring themes salient to that experience. *Attention:* Fifty-six words used to describe CFS were extracted from the interviews and workshop. *Interpretation:* The real-life examples described by patients and clinicians were used to develop 40 ambiguous test items for the IB task, which tapped into the three overarching themes of (i) perceived effort (ii) catastrophic thinking (iii) misattributions of emotions and sensations. The test materials were short descriptions of an ambiguous scenario which could be interpreted in either a positive or somatic way (Appendix B1).

Example 2. Interviews with six breast cancer survivors explored issues of most concern, with open questions regarding their experiences and worries. *Attention:* Fifty-eight

cancer-related words were identified from previous literature and interviews. *Interpretation:* Key themes associated with breast cancer survivorship were identified from the interviews; (i) fear of cancer recurrence (ii) symptom attribution (iii) concerns about the future and (iv) adjusting to life after treatment for cancer. Fourteen test materials for the IB task were developed to tap into these themes. Test materials consisted of descriptions of an ambiguous situation and statements offered a positive or negative interpretation of the situation (Appendix B2). Test materials were piloted in the next step.

Step 3: Piloting the face validity

The next step is to pare down the accumulated specific and nonspecific materials by selecting items with the best face validity. Similar to the development of questionnaires, this process involves piloting materials with a sample of the target population and conducting think aloud sessions to examine if instructions are understood and interpreted in the expected way.

Example 1. Attention: A survey was conducted to determine which of the 56 illness related words identified in steps 1 and 2 were likely to be of current concern, since this will enhance the likelihood that potential AB in CFS will be identified. Participants rated the salience of each word to their experience of CFS (Appendix A). Fifty-eight CFS participants completed the survey. Mean ratings were calculated per word, with higher scores reflecting a greater emotive valence. Twenty-four highest scoring words were selected for the AB task. Words with the highest ratings broadly related to symptom experience (e.g. ‘shattered’) and associated consequences (‘bedbound’).

Interpretation: A second pilot survey was set up for the IB task which included patients with CFS and healthy controls. The survey consisted of 40 short ambiguous scenarios, with the last word left blank. Participants had to complete the last word, thus revealing their interpretation of the text (Appendix B1). For example, ‘You have planned to

clean the downstairs of your house today and found this easier and quicker than you expected. You think if you carry on you will feel In this example potential completions could be exhausted or pleased'. Twenty-six CFS participants (Fukuda et al., 1994) and 26 healthy participants completed the survey. The single word completions were rated by two independent researchers, as CFS-related, generally negative, neutral or positive. Inter-rater reliability was high (97% consensus). The scenarios which demonstrated the biggest difference between the groups in terms of CFS-related interpretations, and the scenarios which resulted in consistent conceptually related interpretations in the CFS group were developed into full text materials for the main IB task (Appendix C1).

Example 2. Attention: Stimuli for the AB task were rated for their relevance by 90 breast cancer survivors. Fifty-eight cancer related words, 64 general and 60 neutral words were separately rated on a 5 point scale for (i) the degree of threat (ii) and relevance to cancer. Twenty-four words that were most highly rated in terms of threat and cancer dimensions were selected for the AB task and matched by length and frequency to neutral words.

Interpretation: To test the stimuli for the IB task, breast cancer survivors (n=8) were asked to complete a pilot version of the task whilst conducting a think-aloud session with a researcher. This revealed that participants were rating statements according to their own experiences rather than how closely each statement matched the original scenario. Subsequent revisions were made to the instructions of the task and piloted with 51 breast cancer survivors. This piloting demonstrated low internal reliability and frequent endorsement of foil statements; suggesting participants might be forgetting the content of the original scenarios. The task was revised to more clearly differentiate target statements from foils and include expanded titles to make it easier for participants to recall the content of each

scenario and piloted with 44 breast cancer survivors. Twelve materials with highest face validity were selected for the final IB task (Appendix C2).

Hypothesis testing

In order to test the relevant hypothesis, these illness specific materials need to be paired with control stimuli. The choice of control stimuli is very important as low frequency (unusual) words take longer to process (Moss-Morris et al., 1996). However, many studies fail to report how control stimuli were decided upon (see Hughes et al., 2016 for discussion of this issue). In order to select the control stimuli for the CFS and cancer AB tasks, illness-related and control words were matched in terms of semantic properties that affect reading speed, including word length, number of syllables per word, and frequency of occurrence of each word in the English language. The open source ‘English Lexicon Project’ (Balota et al., 2007) was used to identify neutral words with matched properties with a paired illness-related word. This is an important step as if words are not matched, one cannot unequivocally interpret differences in reaction time for illness-related and control words as being due to the ‘saliency’ of the words.

In tasks in which pictorial stimuli are used, illness-related and control stimuli should be matched in terms of basic perceptual features, such as overall complexity and brightness, which are likely to influence the allocation of attention, especially the rapid orienting of attention (Egeth & Yantis, 1997). Images should be rated, piloted and validated much in the same way as word stimuli.

In terms of matched materials for the IB tasks, items need to be carefully worded to allow for a positive but realistic interpretation of the earlier text. These positive interpretation items should have similar length and semantic structure to the negative interpretation item. Similarly, to the AB task, if this is not achieved, one cannot rule out the effect of these variables on the phenomenological characteristics observed.

For cross-sectional studies, comparative control groups should be matched to the sample population on variables that may affect their performance on the experimental tasks such as, cognitive ability, age and dexterity. It may be necessary to include an additional clinical control group in order to allow further discrimination between findings being attributed to general clinical characteristics (e.g. pain across different diseases) or findings specific to a particular physical health condition.

Other conceptual and experimental issues to consider

How threatening is too threatening?

In the real world it is adaptive for people to orientate towards highly threatening stimuli. Research has found that most people orientate towards high threat and away from mild threat (Mathews & Mackintosh, 1998; Mogg & Bradley, 1998); thus for group differences to be identified stimuli need to hold optimal levels of threat intensity for the population.

Stimulus modality

The optimal stimuli modality may differ according to the population being studied. For example, studies in CFS have found attentional biases for word stimuli but not images (Hou et al., 2008; Hou et al., 2014) whereas studies of chronic pain have identified an AB for pain related faces and words (Pincus & Morley, 2001; Schoth et al., 2012). This may indicate that in some conditions facial stimuli carry ecological relevance (Dear, Sharpe, Nicholas, & Refshauge, 2011), whereas in other conditions, such as CFS, patients think about their condition and symptoms verbally, thus linguistic stimuli hold greater ecological validity (Hou et al., 2008). However it may be that these mixed findings are due to procedural variables that affected the presence and magnitude of an AB (Crombez, Van Ryckeghem, Eccleston, & Van Damme, 2013).

Stimuli duration

In AB tasks the duration of stimuli presentation or ‘stimulus onset asynchrony’ (SOA) is manipulated to tap into different stages of processing. Generally researchers have used SOA of 1000ms or more to infer the maintenance of attention and shorter SOA’s of 200ms or less tap into earlier, more ‘automatic’ processing (Koster, De Raedt, Goeleven, Franck, & Crombez, 2005; Mogg, Bradley, De Bono, & Painter, 1997). Similarly, modifications of IB tasks allow researcher to tap into more automatic (e.g. Hirsch & Mathews, 2000) versus controlled processing (e.g. Stopa & Clark, 2000). Researchers should refer to literature in their field to help them decide the stage of processing they wish to tap into (see Hirsch et al., 2016). However, it is important to note that the distinction between earlier and later stages, or automatic and controlled processing is not clear cut and these paradigms offer only a snapshot of cognitive processing at a given time. Further studies and alternative methodologies are needed to explore the interplay between stages of processing.

Relatedly, these types of reaction time paradigms are restricted to assessing biases for words or images which hold an immediate or salient meaning. However, the concepts under scrutiny are often ones which cannot always be clearly and succinctly defined. For example, people with CFS often use metaphors or ‘as if’ statements to describe their symptoms. If singular words or images do not capture the distinctive sensory qualities of the object of threat they will not elicit a bias. Tasks which allow more vivid representation of the object of threat, such as the primary task paradigm (Crombez, Eccleston, Baeyens, & Eelen, 1998), could explore how the distinctive sensory qualities of the object of threat affects cognitive processing.

Cognitive ability

Cognitive ability affects reaction time (Deary & Der, 2005), recall (Reijnders, van Heugten, & van Boxtel, 2013) and reading ability (Wang & Gathercole, 2013), thus affecting

participants' performance on experimental tasks. Children and adolescents (Burgaleta, Johnson, Waber, Colom, & Karama, 2014) can show meaningful cognitive ability changes within relatively short developmental periods. Other populations such as the elderly (Rebok et al., 2014) and those on certain medications such as anticholinergic drugs (Fox et al., 2014), may have reduced cognitive ability. Researchers studying such populations should ensure they consider the level of sophistication of the language and that the SOAs are appropriate for the target population.

Conclusions

With experimental research in health psychology growing, there is an exciting opportunity for the field to identify key cognitive processes that may help maintain distress and guide development of novel interventions to target these mechanisms and improve well-being. In order to do this, the key processes need to be assessed with materials that map onto the cognitive processes specific to a given health problem. We believe that adopting the suggested approach detailed here will aid researchers as they begin adapting these paradigms for different populations. Materials used in experimental tasks should be subject to the same rigorous development and validation as self-report questionnaires to ensure materials are reliably tapping into the concept(s) of interest. We encourage researchers to make their materials available alongside published work to aid further transparency about the inferences that can be drawn from the study. This preliminary stimuli development work is essential in order to develop a body of high quality, replicable experimental research.

Traditional health psychology models have largely focused on the role of reflective intentioned action and beliefs (Sheeran et al., 2013). Experimental research adds another dimension to these models by exploring the more implicit drivers of health behaviours and coping. Extant treatments have principally engaged conscious processes via explicit communication (e.g. persuasive information, problem solving, planning, and implementation

intentions). Health psychology interventions may be optimized by additionally targeting these implicit processes. For example, reducing AB to food cues may in turn reduce impulsivity and thereby help regulate impulsive eating (Bongers et al., 2015). There may also be a role for implicit processing in coping. For example, if survivors of breast cancer have persistent AB for cancer related information and tend to interpret ambiguous information as cancer related, they may consequently experience increased anxiety and fear of recurrence (Glider et al., 2007). Modifying these processes with cognitive bias modification (CBM) techniques will enable hypothesis testing and potentially indicate additional treatment targets, paving the way for new interventions.

To date there is no single protocol for consistent and effective CBM. However, there are some promising findings in anxiety which indicate that when CBM is effective in changing an AB associated reductions in anxiety are observed (Linetzky, Pergamin-Hight, Pine, & Bar-Haim, 2015; MacLeod & Clarke, 2015). CBM techniques may benefit from further specificity, identifying and targeting idiosyncratic content that is personalized and tailored to a specific patient. Such an approach could enable testing processing specificity in heterogeneous conditions such as CFS (Matteo Cella & Chalder, 2010) in which the content of concern may be non-specific and vary markedly across patients.

There are challenges to this material developmental work; it is time consuming, costly, requires additional recruitment and in-depth collaborative work with the population of interest. Nevertheless, we believe this work is worthwhile in order to establish a body of high quality and replicable experimental research within the health psychology literature. We hope this article highlights the value of performing rigorous material/stimuli development and aids researchers to engage in this process.

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Figure 1. Flow Diagram for Attentional Bias Stimuli Development

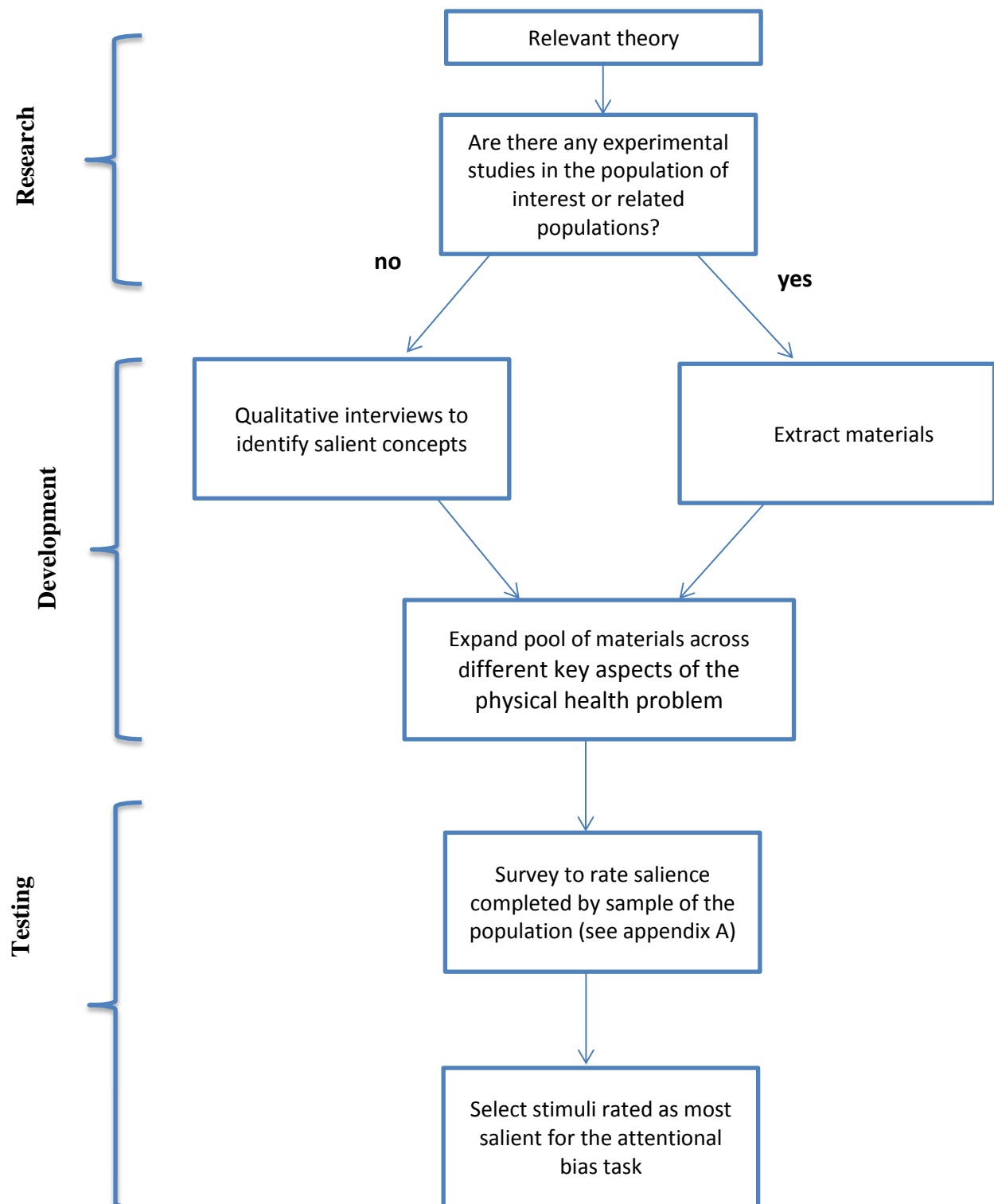
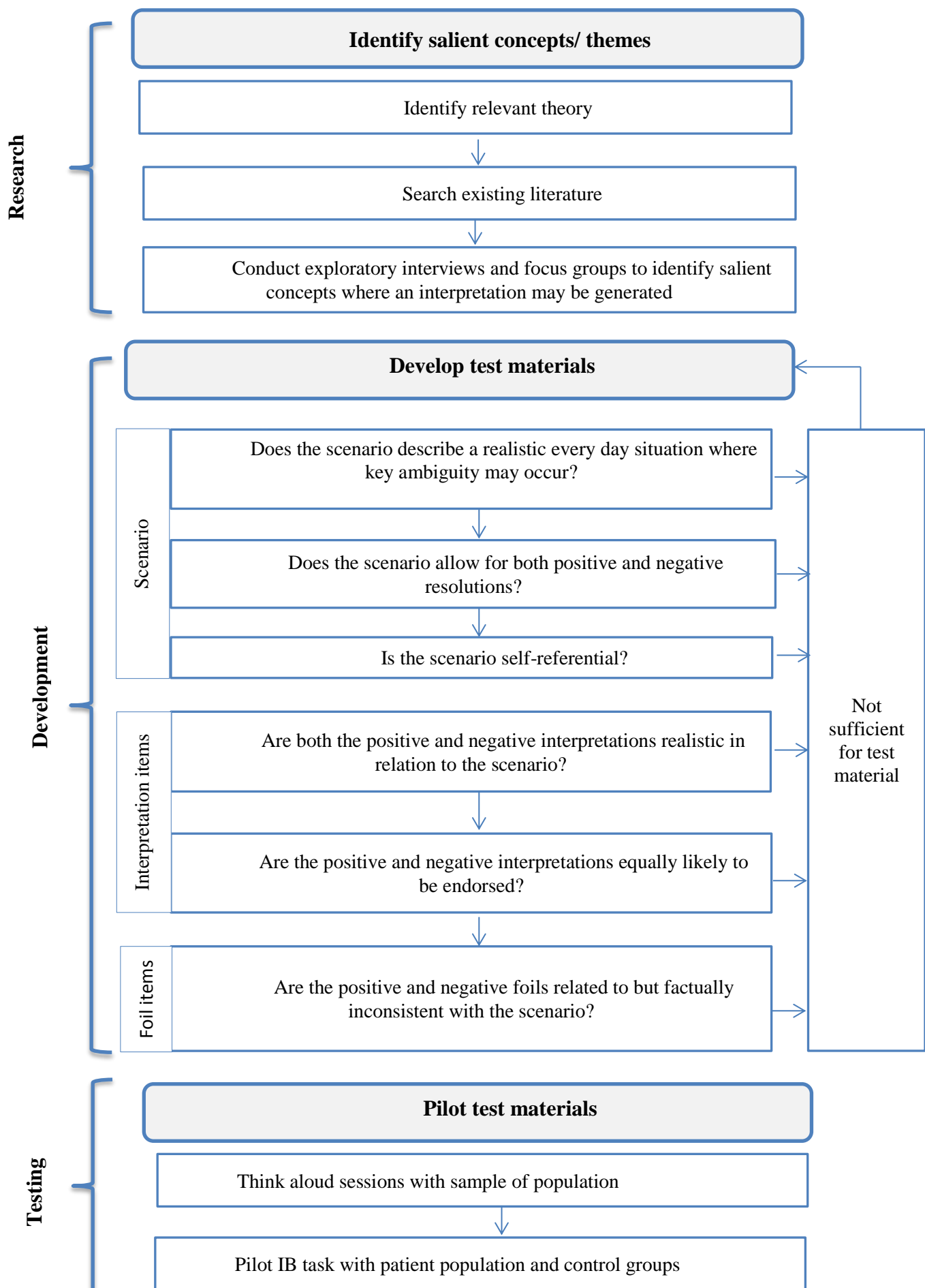


Figure 2. Flow diagram for Interpretative Bias Stimuli Development



APPENDIX A.

Templates for Attentional Bias stimuli pilot surveys

Template 1.

You will be asked to rate a list of words in terms of how personally emotive or distressing you feel they are. I.e. the degree to which the word brings to mind an unpleasant or distressing emotion related to your INSERT CONDITION.

Recalling a time when you were experiencing your worst symptoms, please rate these words in the degree to which they bring to mind an unpleasant or distressing emotion related to INSERT CONDITION.

	Not at all distressing	Neutral	Moderately distressing	Quite a bit distressing	Extremely distressing
Word	0	1	2	3	4
Word	0	1	2	3	4

Template 2.

The following five pages contain lists of words. Some may be related to INSERT CONDITION, others less so. Please indicate on a scale from 1-5 how INSERT CONDITION related each word seems to you.

Please give us your first impressions and try to work as quickly and accurately as possible.

	Not at all related	A little related	Somewhat related	Quite a bit related	Very much related
Word	0	1	2	3	4
Word	0	1	2	3	4

The following five pages contain lists of words. Some may appear threatening, others might not. Please indicate on a scale from 1-5 how threatening each word seems to you.

Please give us your first impressions and try to work as quickly and accurately as possible.

	Not at all	A little	Somewhat	Quite a bit	Very much
	threatening	threatening	threatening	threatening	threatening
Word	0	1	2	3	4
Word	0	1	2	3	4

APPENDIX B
Pilot surveys' for IB materials

B1. Pilot survey for CFS population

Please imagine yourself in these scenarios and complete the sentences with the first word that comes to mind.

For example: 'It is winter and you are outside. You notice yourself shivering which is a sign you are ...*cold*'

1. You spent the afternoon shopping and by the time you get home you feel tired. You slept many hours that night and when you wake up you feel...
2. You have planned to clean the downstairs of your house today and found this easier and quicker than you expected. You think if you carry on you will feel...
3. A friend has just asked you to go for a walk with them. You think the walk would be...
4. You are going on holiday tomorrow and have had a busy day packing. When your alarm wakes you up in the morning you feel...
5. You have attended a family occasion and had an enjoyable time. It was a long day and by the end you feel very tired. You think in a couple of days you will feel...
6. You usually get the bus to work but today you are feeling energetic and decided to walk. When you come home from work you feel more tired than usual. You think tomorrow you will feel....

B2. Pilot survey for breast cancer population**Scenario Example**

TITLE: Results from a Blood Test

SCENARIO: You completed treatment and go in to have a follow up blood test. The nurse calls to give you the results, but instead tells you that there are further tests that need to be run. You can tell from the tone of her voice if she is concerned.

QUESTION: Did you receive a call from the nurse? (Yes/No)

Recognition Example

TITLE: Results from a blood test

STATEMENT: The nurse seems busy at clinic she speaks quickly and ends the call

QUESTION: How similar is this to THE ORIGINAL DESCRIPTION you read?

- Very similar in meaning
- Fairly similar in meaning
- Fairly different in meaning
- Very different in meaning

APPENDIX C
Example of Interpretative Bias materials

C1. IB materials for CFS population.

Title: Weekend Break

You and your partner booked to go on a weekend break. You stayed for 2 nights and fitted a lot in. You ended up doing a lot of sight-seeing around the city. As you travel home you think about how you found the weekend.

Did you go on a break with a friend?

1. You had an enjoyable and interesting weekend.
2. You found the weekend exhausting.
3. Your partner booked the holiday as a surprise.
4. You had to come home from the holiday early.

Title: Cleaning the House

Last week you spent a day cleaning the house. You hoovered all the carpets in the house and mopped the kitchen floor. A week later you notice the carpets are dirty and need hoovered again. You think about how you felt after the last time you cleaned.

Did you clean the windows?

1. You felt pleased with how nice the house looked after cleaning.
2. You felt stiff and painful for days as you pushed your body too far.
3. You completed the cleaning quicker than you had expected.
4. You were unable to clean last week as you hurt your back.

Title: Cleaning the Windows

You decide to clean inside the windows today. You finish cleaning the windows downstairs quicker than you expected and move on to clean the upstairs windows. While climbing the stairs you notice how your shoulders and arms feel.

Did you clean the inside windows?

1. Your shoulders and arms feel like they have had a good workout.
2. Your shoulders and arms feel stiff and painful after over doing things.
3. You cleaned both the inside and outside windows quicker than expected.
4. You fell off a ladder after cleaning the outside windows.

Title: The exercise class

You have started going to a beginners exercise class once a week at your local leisure centre. After a month you feel fitter and decide to enroll in the intermediate class. After attending the first intermediate class you notice your arms and legs are sore. You think about what this means.

Do you have a personal trainer?

1. Your limbs will be sore until you get used to your new exercise regime.
2. You will be bed ridden for days as you have pushed your body too far.
3. Your arms and legs feel stronger after a week of your new exercise regime.
4. You decrease your exercise regimen as you are not fit enough to exercise twice a week.

C2. IB materials for breast cancer population

Title: Reading the newspaper

You are reading a section of the newspaper and come across a headline about an article on cancer. You hesitate a moment and continue to read the article. The article tells you how

likely people are to survive in the long-term if they are diagnosed with breast cancer. This makes you think about your own chances of being cured.

Q: Did you read the entire paper?

1: The article makes you think your risk of being cured after breast cancer is high (Positive target)

2: The article makes you think your risk of being cured after breast cancer is low (Negative target)

3: The article makes you think your risk of being diagnosed with a stroke is high (Negative foil)

4: The article makes you think your risk of being diagnosed with a stroke is low (Positive foil).

Title: One year later

You completed treatment a year ago and are reminded of when you were first diagnosed. You think back to how you felt then and compare this to where you are today. You reflect on how your experience of being diagnosed and treated for cancer has impacted your life as it is today.

Q: Were you thinking about what to prepare for dinner?

1: Cancer has impacted your life and is interfering with your ability to get on with life as usual (Negative target)

2: Cancer affected your life during treatment, but it's behind you now and you are moving on (Positive target)

3: You remember the weather was very cold and rainy last year and you were often unwell (Negative foil)

4: You remember the weather was good last year and you enjoyed spending time outdoors
(Positive foil)

Title: The leaflet

You are being treated for cancer and you pick up a leaflet from the doctor's about the disease.

You read it and learn about risks and symptoms of breast cancer recurrence. As you read through the lists you recognise what your own risk might be and consider your prognosis.

Q: Did you read about cancer on a poster?

1: The leaflet says that most people who get cancer feel well most of the time (Positive foil)

2: The leaflet says that most people who get cancer feel sick most of the time (Negative foil)

3: The leaflet says that people who get cancer are likely to die from the disease (Negative target)

4: The leaflet says that people who get cancer are likely to survive the disease (Positive target)

Title: The biopsy

You recently had a biopsy to test a lump on your neck for cancer. You are now sitting in your surgeon's office and he tells you he has the biopsy report. You think you can tell by the look on his face what the results of the biopsy show.

Q: Did the surgeon discuss chemotherapy with you?

1: You can tell by the look on your doctor's face that the result is good news (Positive target)

2: You can tell by your doctor's manner that he is relaxed and not rushed (Positive foil)

3: You can tell by your doctor's tone that he is very busy and in a hurry (Negative foil)

4: You can tell by your doctor's expression that the results do not look good (Negative target)

